REMARKS

Claims 11-13, 16-19 and 22-24 are pending in the above-identified application.

Issues under 35 USC 112

Claims 11-13, 16-19 and 22-24 have been rejected under 35 USC 112, second paragraph, as allegedly being indefinite. It is essentially the position of the Examiner that blue light must have a wavelength within about 450-490 nm which is apparently inconsistent with the recitation in the claims that the claimed aluminate phosphor "emits blue light having a maximum peak wavelength at about 410 nm". This rejection is respectfully traversed.

It is submitted that it is known that aluminate phosphors typically emit blue light over a wavelength range of about 390 nm to 550 nm as is evidenced by the discussion in Wikipedia (www.wikipedia.org) concerning phosphors, and in particular strontium aluminate phosphors activated by europium. This maximum wavelength emission parameter recited in the present claims is understood by those skilled in the art and is consistent with definitions used in this technological area, such that the claims cannot be considered indefinite on this basis. Rather, the claims satisfy the definiteness requirements such that the above rejection must be withdrawn.

Issues under 35 USC 103(a)

Claims 11-13 and 24 have been rejected under 35 USC 103(a) as being unpatentable over Nagahama '857 (US 7,105,857) and in view of Wang (Wang, "Concentration quenching of Eu2+ in Sro-A1203:Eu2+ phosphor", Journal of Luminescence, Volume 97, Issue 1, April 2002, Pages 1-6).

Claims 16 and 20 have been rejected under 35 USC 103(a) as being unpatentable over Nagahama '857, in view of Wang, and further in view of Xu (Xu, "Synthesis of SrA1204 and SrA12019 via ethylenediaminetetraacetic acid precursor," Materials Chemistry and Physics Volume 98, Issue 1, available online 26 September 2005, Pages 51-54).

Claims 17-19 and 21 have been rejected under 35 USC 103(a) as being unpatentable over Nagahama '857, in view of Wang, further in view of Xu, and further in view of Douy (Douy,

"Crystallisation of spray-dried amorphous precursors in the SrO-A1203 system: a DSC study," Journal of the European Ceramic Society 23, 2003, pp 2075-2081).

Claims 22 and 23 have been rejected under 35 USC 103(a) as being unpatentable over Nagahama '857, in view of Wang, in view of Xu, in view of Douy and further in view of Ono '708 (US 2001/0054708).

These rejections are traversed based on the following reasons below.

Present Invention

The aluminate phosphor of the present invention exhibits a strong and maximum wavelength peak at about 410 nm by ultraviolet excitation, as shown in Fig. 2, as well as the result obtained at 1400°C shown in Fig. 5. The aluminate phosphor of the present invention exhibits advantageous emission color properties by varying the temperature of the heat treatment, though the general composition formula of the compound remains the same. The blue phosphor of the present invention having a maximum peak length at about 410 nm is obtained when the aluminate represented by $7(Sr_{1-X}Eu_x)O.yA1_2O_3$ $(0 < x \leq 0.5, 1 < y \leq 36)$ is heated at 1400°C in a reducing atmosphere, whereas a blue-green phosphor having a maximum peak length at about 510 nm is obtained when the aluminate of the same composition formula is heated at 1200-1350°C in a reducing atmosphere. This is evident from a review of Fig. 5 of the present application.

Distinctions over Cited References

Nagahama '857 discloses in column 24 phosphors including $Sr_7Al_{12}O_{25}$:Eu. As stated in the Office Action, Nagahama '857 fails to disclose the europium doping concentration. Also, Nagahama '857 fails to disclose or suggest any basis for a motivation or method for obtaining aluminate phosphor of the present invention having the properties recited in the present claims.

Wang discloses an aluminate phosphor represented by the general composition formula: $Sr_{1-x}Eu_xO.A1_2O_3$ $(0.01 \leq x \leq 0.124)$. Wang fails to disclose the aluminate phosphor of the present invention which emits blue light having a maximum peak wavelength of 410 nm. The phosphor of Wang does not emit blue light having a maximum peak wave length at about 410

nm by ultraviolet excitation. In the emission spectra of Wang, though two emission bands are observed at 415 and 516 nm, the maximum peak wavelength is clearly at 516 nm (Wang, Fig. 1(b) and §3.1). In Wang, the peak strength at 415 nm is much lower than that at 516 nm, and the peak at 415 nm is observed at a low level only when the value of x is 0.106. In Wang, since the aluminate phosphor is obtained by calcining the aluminate $Sr_{1-x}Eu_xO.Al_2O_3$ ($0.01 \leq x \leq 0.124$) at 1300°C in a reducing atmosphere (Wang, §2), the aluminate phosphor of Wang emits green-blue light having a maximum peak wave length at 516 nm by ultraviolet excitation.

Wang also fails to disclose or suggest conducting the heat treatment at about 1400°C to obtain the aluminate phosphor of the present invention. This is a surprising discovery made by the inventors of the present application that the emission color of the phosphor can be varied according to the temperature of the heat treatment. Consequently, significant patentable distinctions exist between the present invention and both the Nagahama '857 and Wang references, such that the rejections based on these references should be withdrawn.

Response to Assertions in Office Action

In the Office Action of January 14, 2009, the Examiner states two assertions at page 4 that are incorrect. First, it is stated that, "Phosphors of the same composition must necessarily have the same properties. As the same composition cannot have two mutually exclusive sets of properties." Second, it is stated that, "...the emission peaks of a phosphor are dependant upon excitation wavelength and the peak emission wavelength and the overall color of emission can change based on excitation wavelength." These assertions are incorrect based on the following reasons.

Same Molecular Formula and Different Structure Can Result in Different Properties

Regarding the first assertion identified immediately above, it is evident that the aluminate phosphor of the present invention has same general molecular formula as the phosphor $Sr_7Al_{12}O_{25}$:Eu of Nagahama '857. However, the aluminate phosphor of the present invention has a unique crystalline structure that is not specified or suggested by the phosphor $Sr_7Al_{12}O_{25}$:Eu of Nagahama '857. In this regard, note that in Fig. 4 of the present application, X-ray diffraction patterns of $7(Sr_{1-x}Eu_x)O.yAl_2O_3$ are shown. For example, the X-ray diffraction pattern of $7(Sr_{1-}$

$_xEu_x)O.6Al_2O_3$ of Experiment No. 3 in Fig. 4 is shown to closely resemble that of $Sr_7Al_{12}O_{25}$. This result suggests that the aluminate phosphor $7(Sr_{1-x}Eu_x)O.6Al_2O_3$ may have the same structure as $Sr_7Al_{12}O_{25}$, even though the former includes doped Eu and the latter does not. Thus, the structure including doped Eu can not be detected by using X-ray diffraction analysis. It turns out that in the aluminate phosphor $7(Sr_{1-x}Eu_x)O.6Al_2O_3$ of the present invention, some Sr atoms in the crystalline structure are substituted with Eu atoms. However, one can not detect at which sites the Sr atoms of $Sr_7Al_{12}O_{25}$ are substituted with Eu atoms by the X-ray diffraction analysis.

Further, Fig. 5 of the present application shows that the aluminate phosphor $7(Sr_{1-x}Eu_x)O.6Al_2O_3$ of the present invention exhibits a varying maximum peak wavelength of emitted light between the heating temperatures 1350°C and 1400°C. This result suggests that though the general molecular formula of $7(Sr_{1-x}Eu_x)O.6Al_2O_3$ may not change, structural differences with corresponding property differences (i.e. different emission properties) arise due to differences at sites wherein Eu atoms have taken the place of Sr atoms depending on the heating temperature. Although it is not known exactly how the substitution sites differ in the aluminate phosphor of the present invention, it is clear that these substitution sites change between 1350°C and 1400°C. Thus, the aluminate phosphor of the present invention cannot be alleged to be equivalent to any of the phosphors disclosed in either Nagahama '857 or Wang.

Peak Emission Wavelength and Emission Color Not Dependent upon Excitation Wavelength

In response to the second assertion in the Office Action noted above, it is submitted that as shown in Figure 12 of enclosed Exhibit A (W. M. Yen, S. Shionoya and H. Yamamoto: Phosphor Handbook, 2nd ed., CRC Press, 2007), emission occurs when an electron of an emitting ion in a phosphor transitions from the equilibrium position C of an excited state to the vertical transition position D of a ground state. The energy difference between the positions C and D is inherent in the phosphor and defines a peak emission wavelength and an overall color of emission.

Likewise, optical absorption occurs when the phosphor transitions from the equilibrium position A of the ground state to the vertical transition position B of the excited state. The energy difference U_1 between the positions A and B is also inherent in the phosphor. Further,

the phosphor of the position B loses energy by generating lattice vibration and relaxes to the equilibrium position C. Therefore, using excitation light having a shorter wavelength (i.e. having higher energy) results in increased unabsorbed energy or increased lattice vibration energy. However, the peak emission wavelength and the overall color of emission remain unchanged.

Accordingly, even if the phosphor $Sr_7Al_{12}O_{25}$:Eu of Nagahama '857 were to be excited by the more intense light having a wavelength lower than 380 nm, for example light of 260 nm as in the present invention, the peak emission wavelength and overall color of emission would be the same if the phosphor $Sr_7Al_{12}O_{25}$:Eu were to be excited by light of 380 nm.

In addition, it is noted that Nagahama '857 discloses the green phosphor $SrAl_2O_4$:Eu at column 24, line 63 which is the same phosphor disclosed in Wang as an aluminate phosphor represented by a general composition molecular formula: $Sr_{1-x}Eu_xO.Al_2O_3$ ($0.01 \leq x \leq 0.124$). In Wang, the aluminate phosphor $Sr_{1-x}Eu_xO.Al_2O_3$ ($0.01 \leq x \leq 0.124$) is excited by the light of 254 nm to emit light having a maximum peak wavelength at 516 nm. The light of 516 nm is green. From the fact disclosed in Nagahama '857 and Wang, one can easily understand that the overall color of the phosphor $SrAl_2O_4$:Eu is not dependant upon excitation wavelength and the peak emission wavelength and the overall color of emission can not change based on excitation wavelength. Accordingly, the above-noted assertion cannot be relied up to allege that the present claims are obvious over either Nagahama '857 or Wang or the combination thereof.

Distinctions over Other Cited References

The other cited references fail to make up for any of the above-noted deficiencies regarding Nagahama '857 or Wang. Xu discloses $SrA1_2O_4$ and $SrA1_{12}O_{19}$ as aluminates, but fails to disclose how to obtain $SrA1_2O_4$ and $SrA1_{12}O_{19}$ aluminates that emit blue light. Xu fails to disclose or suggest varying the emission color of $SrA1_2O_4$ based on the heat treatment temperature. Further, $SrA1_{12}O_{19}$ is not included in the aluminate of the present invention represented by $7(Sr_{1-4}Eu_x)O.yA1_2O_3$ ($0 < x$ 0.5, $1 \leq y \leq 36$), since the value of y in $SrA1_{12}O_{19}$ is calculated to be 42. Regarding $SrA1_2O_4$, though the value of y for $SrA1_2O_4$ is calculated to be 7, the calcining temperature to obtain $SrA1_2O_4$ is 1300°C or less, not 1400°C as in the process of

the present invention. Consequently, significant patentable distinctions exist between the present invention and Xu, such that the rejections based on this reference should be withdrawn.

The additional references cited in support of the above rejections, i.e. Douy and Ono '708, are farther removed from the present invention and both fail to make up for the deficiencies of the Nagahama '857, Wang and Xu references discussed above. Thus, the rejections based on these references should also be withdrawn.

It is submitted for the above reasons that the present claims define patentable subject matter such that the present application should be placed into condition for allowance.

It is submitted for the reasons above that the present claims define patentable subject matter such that this application should now be placed in condition for allowance.

If any questions arise in the above matters, please contact Applicant's representative, Andrew D. Meikle (Reg. No. 32,868), in the Washington Metropolitan Area at the phone number listed below.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.17; particularly, extension of time fees.

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Respectfully submitted,

By _____

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Enclosures: Exhibit A